Hand eczema

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Chapter

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Severe bullous allergic contact dermatitis caused by glycidyl methacrylate and other acrylates

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Cases of contact allergy to acrylates are described quite frequently in, for example, dentists, prosthesists, and printers. In this case report, we describe a rarer case of a severe allergic contact dermatitis caused by acrylates in an occupational setting.

Case Report

A 50-year-old healthy man was seen at the outpatient clinic after he had suffered two episodes of skin lesions on his left knee, right wrist, and left ring finger (Fig. 1ab). A few hours after he had finished his work, these lesions appeared as burning, indurated redness, developing into tense blisters within 24 hr. The lesions healed without scar formation within 10 days. An occupational dermatitis was suspected, and history taking revealed that, for three years, the patients had been working as a process operator in the production of semi-finished products. He controlled production processes and manually added chemicals, ammonium persulfate and different liquid acrylates, in a semiclosed process. Material safety data sheets provided by the employer showed that these liquid acrylates included 1,6-hexanediole diacrylate (HDDA) and glycidyl methacrylate (GMA). As protection, the patient wore chemical-resistant, but liquid-permeable, clothing. In addition, he wore protective gloves: cotton gloves with a rubber coating on the palmar sites of the gloves for use during dry activities, and thick nitrile gloves with a cotton lining when handling liquids. He changed his clothes a few times a week and his gloves once or twice a day, depending on his activities.

Patch testing with the European baseline series (TRUE Test ®; Mekos Laboratories AS, Hillerød, Denmark) and our additional series was performed, together with a (meth)acrylate series (Chemotechnique®, Vellinge, Sweden), ammonium persulfate 2.5% pet., and products from the patient's workplace, namely the industrial acrylates GMA and HDDA, in a dilution series (obtained from the Department of Occupational and Environ-mental Dermatology, Skåne University Hospital, Malmö, Sweden), under 48 hr of occlusion. The test materials were prepared shortly before application, in order to prevent evaporation of the acrylates. Reactions to the tests were read according to the ICDRG criteria at D2, D3 and D7 after application. The patient reacted neither to the baseline series, nor to ammonium persulfate. However, multiple strong positive reactions were seen to the (meth)acrylates series and the industrial acrylates GMA and HDDA (Fig. 1c–h, Table 1). Besides AQ5 the severe reactions to the patch test materials on his back, he showed a serous crust on his forehead (Fig. 1i). This was interpreted as a recall reaction resulting from local skin memory.

The patient was advised to take strict protective measures against all traces of acrylates, including unnoticed spatter and spill of products containing acrylates. If handling of acrylate-containing products was inevitable, he should wear impermeable, three-layered laminated gloves made of polyethylene/ethylene vinyl. Nitrile gloves were unsuitable for this purpose, because of their short breakthrough time.

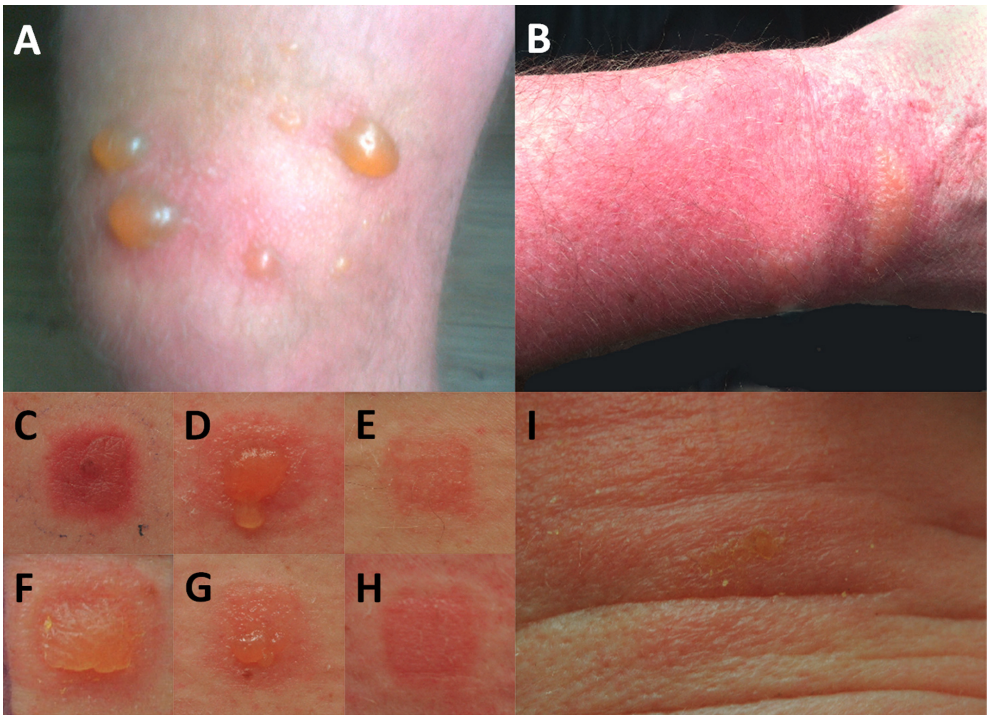

Fig. 1. (a,b) Tense blisters on the left knee and right wrist 24 hr after occupational exposure to the acrylates glycidyl methacrylate (GMA) and 1,6-hexanediole diacrylate (HDDA). (c–e) Patch test results for GMA. From left to right: pure GMA 1% pet., industrial GMA 0.3% pet., and industrial GMA 0.1% pet. (f–h) Patch test results for HDDA. From left to right: pure HDDA 0.1% pet., industrial HDDA 0.3% pet., and industrial HDDA 0.1% pet. (i) Serous crust on the patients' forehead, resulting from local skin memory.

Discussion

We have described the first case of an occupational bullous allergic contact dermatitis caused by GMA and HDDA.

HDDA (CAS 13048-33-4) belongs to the group of multifunctional acrylates. These acrylates are used in dentistry, and are important components of printing inks and waterproof coatings. They are all strong irritants and potent sensitizers. Contact allergies are almost exclusively seen in an occupational setting.[1]

GMA (CAS 106-91-2) is a potent sensitizer; it is an ester of methacrylate acid and epichlorohydrin forming a methacrylate monomer. Apart from a moderately reactive methacrylate group, it has an extremely reactive epoxy group. GMA has a wide range of applications, including the production of semi-finished products, as in the case of our patient's factory. Moreover, GMA is also used to impregnate clothing and paper, for the production of waterproof sealings, and in dentistry techniques and orthopaedics.[2]

(Meth)acrylate series	D2	D3	D7
Ethyl acrylate (EA) 0.1% pet.	++	++	+
Butyl acrylate (BA) 0.1% pet.	++	++	+
2-Ethylexyl acrylate (2-EHA) 0.1% pet.	+	?	-
Hydroxyethyl acrylate (2-HEA) 0.1% pet.	++	++	+
2-Hydroxypropyl acrylate (2-HPA) 0.1% pet.	++	++	+
2-Hydroxyethyl methacrylate (HEMA) 2% pet.	-	?	?
2-Hydroxypropyl methacrylate (HPMA) 2% pet.	?	+	+
Ethyleneglycol dimethacrylate (EGDMA) 2% pet.	-	?	-
Triethylene Glycol Dimethacrylate (TEGDMA) 2% pet.	+	+	?
1,4-Butanediol dimethacrylate (BUDMA) 2% pet.	++	++	+
1,4-Butanediol diacrylate (BUDA) 0.1% pet.	+++	+++	+
1,6-Hexanediol diacrylate (HDDA) 0.1% pet.	+++	+++	+
Diethyleneglycol diacrylate (DEGDA) 0.1% pet.	+++	+++	+
Tripropylene glycol diacrylate (TPGDA) 0.1% pet.	?	+	?
Oligotriacrylate (OTA480) 0.1% pet.	-	+	-
Epoxy acrylate (bis-GA) 0.5% pet.	?	+	?
Urethane diacrylate, aliphatic (al-UDA) 0.1% pet.	+	++	++
Glycidylmethacrylate (GMA) 1% pet.	+++	+++	+++
Dilution series industrial HDDA and GMA			
HDDA 0.01% pet.	-	-	-
HDDA 0.03% pet.	?	+	-
HDDA 0.1% pet.	+	+	+
HDDA 0.3% pet.	+++	+++	+++
GMA 0.01% pet.	-	-	-
GMA 0.03% pet.	?	?	-
GMA 0.1% pet.	+	++	+
GMA 0.3% pet.	+++	+++	+++
GMA 1% pet.	+++	+++	+++

Table 1. Positive patch test results for the (meth)acrylates series and the dilution series of the patient's own industrial acrylates. GMA, glycidyl methacrylate; HDDA, 1,6-hexanediole diacrylate.

Furthermore, contact allergies to GMA have often been described in nail stylists. A severe irritant bullous reaction after occupational contact with GMA was described by Shimizu *et al.* in 2008.[3] The multiple reactivity to various acrylates in this patient can be explained by two different phenomena: first, the phenomenon of cross-reactivity, owing to the almost identical molecular structures of different acrylates or transformation to the same molecular structure; and second, contamination of acrylates with and subsequent exposure to other acrylates

used in an industrial setting, as most acrylates contain up to 20% contamination.[4,5] Our analysis of GMA and HDDA showed that both substances had been contaminated by other acrylates (Table 2).

GMA	
Pure GMA	97%
HDDA	0.5%
2 probable methacrylates, not identified	1.7%
Dichloropropanol	0.2%
HDDA	
Pure HDDA	93%
5 acrylates, not identified	6.5%

Table 2. Results of analysis for confirmation of purity of glycidyl methacrylate (GMA) and 1,6-hexanediole diacrylate (HDDA) in the industrial products by gas chromatography and mass spectrometry.

Making the distinction between a severe irritant reaction and a severe contact allergic reaction, as in the case described, is often difficult. A very low concentration of any acrylate can initiate a very severe reaction. For this reason, a dilution series of the product was tested to determine the origin of the reaction.[6]

The recall reaction on the patient's forehead might have been attributable to local skin memory. This memory function of the skin was first described by Scheper *et al*.[7] In this case, the memory recall might have been caused by the severe patch test reactions on the patient's back combined with earlier contact with one of these acrylates on his forehead. Furthermore, the absence of any reaction on his left knee, right wrist and left ring finger still leaves some questions.

This case report stresses the importance of patch testing with a dilution series of acrylates to distinguish between a contact allergy and an irritant reaction. Moreover, it emphasizes the importance of investigating the products in a patient's workplace and testing the purity of these products.

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